Remarks

Claims 1-10 are pending in the above captioned application. Claims 1-10 stand rejected. Claims 1-10 have been amended to return the claims to as originally filed, with the exception of the correction of obvious typographical errors in claims 1 and 6 as originally filed, and also with the exception of amending claim 7 to remove the Examiner's objection to the use of "horizontal" and "vertical" in the claim as originally filed.

Applicants submit that the Examiner's prior rejections of the claims under 35 U.S.C. §102 (e) as anticipated by United States Patent No. 5,978,409, entitled LINE NARROWING APPARATUS WITH HIGH TRANSPARENCY PRISM BEAM EXPANDER, issued to Das, et al. on November 2, 1999 ("Das"), or under 35 U.S.C. §103 (a) as unpatentable over Das and P. Zorabedian, "Characteristics of a Grating-External-Cavity Semiconductor Laser Containing Intracavity Prism Beam Expanders", IEEE, Journal of Lightware Technology, Vol. 10, No. 3, March 1992, pp. 330-35 ("Zorabedian") are not proper. The subject matter of the claims as filed is not, as the Examiner has asserted, found in Das. Neither does the combination of Das and Zorabedian provide a *prima facie* case for obviousness, since the combination lacks all of the elements of the claimed invention as set forth in the claims as originally filed.

The Examiner has taken the position that Das "teach a laser comprising: a first direction bean expander (26,30), a second direction beam expander (32) and a grating (36) (see Fig. 2 and "Background of the Invention").

What Das discloses is:

> A grating based line-narrowing apparatus having a prism beam expander with at least four prisms. Each prism is positioned at an incidence angle between 67 and 71 degrees. A single layer coating of high refractive index, robust material, such as Al_2O_3, is applied to the hypotenuse face of each prism, providing an efficient, anti-reflection coating. (Abstract)

The disclosed and claimed invention in Das is meant to solve a problem created in the prior art by the use of only three prisms in the beam expander as noted in Das:

> Unfortunately, the 20 times magnification requirement using three prisms means that the light incidence angle on the hypotenuse of the prism needs to be about 74

degrees. It is very difficult to make an AR coating at 193 nm for such a large incidence angle. At this angle, the reflection reduction efficiency of the stack of quarter-wave layers is reduced dramatically, so that the required number of layers is substantially increased and the thickness and density tolerance on each layer is greatly tightened. In addition, the choice of materials with good transmission at such a short wavelength is greatly limited, ... (Col. 3, lines 32-43)

In order to overcome this problem, Das teaches an invention in which:

The present invention provides a grating based line-narrowing apparatus having a prism beam expander with at least four prisms. Each prism is positioned at an incidence angle between 67 and 71 degrees. A single layer coating of a high refractive index, robust material, such as Al_2O_3, is applied to the hypotenuse face of each prism, providing an efficient, anti-reflection coating. In a preferred embodiment the incident angle of the four prisms are each at about 68.2 degrees. ... The primary benefit of the new four prism arrangement is that the prism coatings should be much less expensive and have greatly increased durability. (Col. 3, lines 7-20)

Similarly the disclosure of Zoradian shows a beam expander that expands the beam in only one direction of expansion. This is shown by the discussion in Zorabedian:

The approach taken in this work was to use a short focal length collimating lends to produce a narrow pencil beam and then to increase the tangential beam width at the grating with anamorphic prism[1] beam expanders. (p.330)

Zoradian also explains:

A example of the cavity which follows this approach is shown in Fig. 1. It contains a laser diode as the gain medium a collimating objective, a chain of prisms placed stagger with respect to the optic axis, and a Littrow-mounted diffraction grating. Other examples can be obtained by varying the number of

[1] Anamorphic prisms are used to change the dimension of a beam in one axis, the effect being analogous to that of a cylindrical lens. Depending on the orientation of the prisms, the beam size may be either reduced or expanded and the amount of change is variable depending on the angular position of the prisms. See http://www.optima-prec.com/prism.htm.

prisms as well as their refractive indices, angles of incidence, and apex angles. (p. 331)

Nowhere in Das or Zorabedian is there a disclosure or suggestion in the text, nor do the drawings show or suggest, that the beam is to be expanded first in one *direction of expansion* and then in a generally orthogonally oriented second *direction of expansion*, nor hint at the recognition of the problem being addressed by the present invention. In fact all of the drawings in both Das (e.g., Fig.s 2 and 6) and Zorabedian (Fig.'s 1 and 3) clearly show prisms aligned to expand the beam in a *single direction of beam expansion*.

The Examiner has taken the position that during prosecution the claims must be "given the broadest reasonable interpretation consistent with the specification", citing M.P.E.P. §2111. Applicants certainly agree that this is the case but respectfully assert that the examiner's interpretation if overly broad and unreasonable and not consistent with the Specification interpreted in light of its content and the knowledge and understanding of those skilled in the art.

The problem being addressed by the inventions as disclosed and claimed in the present application is described as follows:

> Because microlithography exposure lenses are very sensitive to chromatic abberation [sic] of the light source, it is required that the laser produce light with very narrow spectrum line width. For example, state of the art excimer lasers are now producing spectral linewidths on the order of 0.5 pm as measured at full width at half maximum values and with 95% of the light energy concentrated in the range of about 1.5 pm. New generations of microlithography exposure tools will require even tighter spectral requirements. In addition, it is very important that the laser central wavelength be maintained to very high accuracy as well. In practice, it is required that the central wavelength is maintained to better than 0.05-0.1 pm stability. (p. 2, lines 27- p. 3, line 3)

To deal with this the applicants have proposed:

> The present invention provides for a grating based line narrowing unit with bi-directional beam expansion for line narrowing lasers. In a preferred embodiment a beam from the chamber of the laser is expanded in the horizontal direction with a three-prism beam expander and is expanded in the vertical

direction with a single prism. A narrow band of wavelengths in the expanded beam is reflected from a grating in a Littrow configuration back via the two beam expanders into the laser chamber for amplification. (p. 3, lines9-15)

In this manner the effect contemplated is explained as follows:

Beam divergence in the vertical direction has significant effect on line narrowing. According to formula (2), different vertical angles .beta. would correspond to different Littrow wavelengths .lambda.. FIG. 3 shows dependence of Littrow wavelength .lambda. on the beam vertical deviation, .beta.. Typical prior art excimer laser might have a beam divergence of up to .+-.1.0 mrad (i.e., a total beam divergence of about 2 mrad). FIG. 3 shows that a portion of a beam propagating with a 1 mrad vertical tilt (in either up or down direction) will have the Littrow wavelength shifted by 0.1 pm to the short wavelength direction for that portion of the beam. This wavelength shift leads to broadening of the whole beam spectrum. Prior art excimer lasers, having $\Delta\lambda_{FWHM}$ bandwidth of about 0.6 pm does not substantially suffer from this effect. However, as the bandwidth is reduced, this 0.1 pm shift becomes more important. New excimer laser specifications for microlithography will require bandwidth of about 0.4 pm or less. In this case, it becomes important to reduce this broadening effect. (p. 4, line 26 – p. 5, line 6)

The Examiner seems to be taking position that the optical axis change in direction that results from the beam passing through the various stages of a beam expander, e.g., one consisting of anamorphic prisms is an expansion of the beam in a new direction each time. This is not what the claims recite.

Claim 1 calls for "a first direction beam expander positioned to expand a beam from the laser in a first direction;" and also for "a second direction beam expander positioned to expand said beam in a second direction." As disclosed, in light of the above explained purpose and desired effect, and, e.g., particularly with regard to FIG.'s 4A-C, the beam expansion directions are the subject matter of the clamed invention and not the direction of the optical axis of the beam as it is expanded. Those skilled in the art, as indicated by the definition of an "annamorphic prism" and the disclosure of Zorabedian itself relating to various configurations of beam expanders resulting in various different

optical axis directions, angles and inclinations to expand a beam in a beam expansion direction, which is not the same as the changes in optical axis of the beam during the expansion in each optical element. Those skilled in the art know that there is a distinction between expanding a beam in a first direction of beam expansion and then in a second direction of beam expansion and that this does not mean that each time the beam is transmited through a given optical element for purposes of expansion in the one direction of beam expansion the resulting change in optical axis is beam expansion in a new direction as the Examiner reads the claims.

Such a reading of the claims is inconsistent both with the Specification of the above captioned application and with the common understanding of beam expansion technology as understood by those skilled in the art.

Therefore, neither Das nor the combination of Das and Zorabedian discloses or suggests the expansion of the beam in one direction and then in another direction as claimed. There is, therefore, no anticipation of claim 1 or 6 and no prima facie case of obviousness. For *prima facie* obviousness all of the claim limitations must be taught or suggested by the prior art.[2] If an independent claim is nonobvious any claim depending from the independent claim is also nonobvious.[3]

Therefore the Examiner's rejections of the claims under 35 U.S.C. §§102 (e) and 103(a)[4] are improper and the Examiner is respectfully requested to withdraw the rejections and allow claims 1-10.

Claim 7 has been amended to remove the examiner's objection to the use of horizontal and vertical in the claim and the specification has been emended to remove the restrictive definition of horizontal and vertical as used in the context of describing the inventions of the above captioned application. Indeed, generally laser systems of the present invention are installed in coordinate systems that are alignable to true horizontal and true vertical, and generally speaking the laser beams have an optical axis that is either

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[2] M.P.E.P. §2143.03. See *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974); *In re Wilson*, 424 F.2d 1382, 1385, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970) (must consider all of the claim language).
[3] M.P.E.P. §2143.03. See *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).
[4] Applicants note that Das is not §103 prior art under §103(c), but Zorabedian discloses exactly the same thing as Das in this regard, according to the Examiner's interpretation of the claims and there are other non-§103 (e) pieces of prior art that show grating line narrowing units having multiple prism beam expanders which would satisfy the same misinterpretation of the meaning of expanding the beam in multiple directions as applied to Das by the Examiner.

in the horizontal or vertical plane at different times. However, they need not be, and particularly, the line narrowing packages need not be oriented so that the principal optical axis of the light beam is aligned to a horizontal or vertical coordinate system axis. In fact, within the understanding of the invention of the above captioned application the more appropriate orientation "horizontal" and "vertical" should be with respect to the grating, regardless of, e.g., the alignment of its longitudinal or lateral axes to either of true horizontal or true vertical. The point of the inventions of the above captioned patent application, as explained in regard to, e.g., FIG. 3 (p 5, line 25 – p. 4, line 7) is to expand the beam in a second direction from that in which it is expanded to spread it over the longitudinal axis of the grating, with enough expansion in that direction and that direction be orthogonal enough to the first direction so as to "reduce [the] divergence of the beam as it illuminates the grating" to drive the cos β term in the optical function of the grating towards 1 to improve the functioning of the grating to narrow the bandwidth of the laser beam.

Conclusions

Claims 1-10 remain in the above captioned application. Claims 1 and 6 have been amended from the as-filed claims solely to correct obvious typographical errors and not to define over any art and without changing the scope or intent if either claim. Claim 7 has been similarly so amended to remove the recitations for which the Examiner found no support in the specification as filed. Without accepting the validity of this objection, the applicants have amended claim 7 with an amendment that actually broadens the claim and is supported by the Specification and drawings as filed.

Applicants respectfully request that claims 1-10 be allowed and this application be issued as a patent.

Applicants authorize the Commissioner to charge our Deposit Account in the amount of $110.00 for the extension of time fee. Applicants do not believe that any additional fees are due, but hereby authorize the Commissioner to charge applicants' assignees' Deposit Account, for any additional fees.

Respectfully submitted,

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